

CHARACTERISTICS OF UGC GALAXIES DETECTED BY IRAS

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Abstract

IRAS detection rates at $60\ \mu\text{m}$ have been determined for the Uppsala General Catalogue of Galaxies (Nilson 1973; the UGC). Late-type spirals, characterised by a 'normal' IR/B ratio of ~ 0.6 , are detected to a velocity of $\sim 6000\ \text{km/s}$ for $L_B = L^*$. Contrary to the situation for IRAS-selected galaxy samples, we find little evidence for a correlation between IR/B and $60/100\ \mu\text{m}$ in this large optically-selected sample. Thus a significant fraction of the IRAS-measured far-infrared flux from normal spirals must originate in the diffuse interstellar medium, heated by the interstellar radiation field. We do not find support for Burstein and Lebofsky's (1986) conclusion that spiral disks are optically thick in the far-infrared.

1. INTRODUCTION

The UGC catalog is the most uniform catalog of optically selected galaxies available, being reasonably complete for high surface brightness galaxies to a blue size limit of $1'$. As one approach to the question of the nature of the power source(s) of the far-infrared emission of galaxies, we have begun an analysis of the characteristics of the subset of the UGC galaxies detected by IRAS. In this contribution we present initial results of our study. A more substantial analysis, including a far-infrared luminosity function, will be submitted to the Ap. J. (Bothun, Lonsdale Persson and Rice 1987).

2. RESULTS AND DISCUSSION

The detection rate of UGC galaxies at $60\ \mu\text{m}$ as a function of morphological type is illustrated in Figure 1a. As first noted by de Jong et al. (1984) the detection rate is low for E and S0 galaxies and increases towards later types. Figure 1b displays the detection rates of early- and late-type spirals in blue magnitude bins. At an equivalent blue magnitude the detection rate of the later spiral types is higher than that of the early types.

Figure 1b also shows that the IRAS detection rate drops steeply beyond about 13.5 mag. Another way to look at the situation is in terms of the IRAS detectability of an L_{opt} galaxy

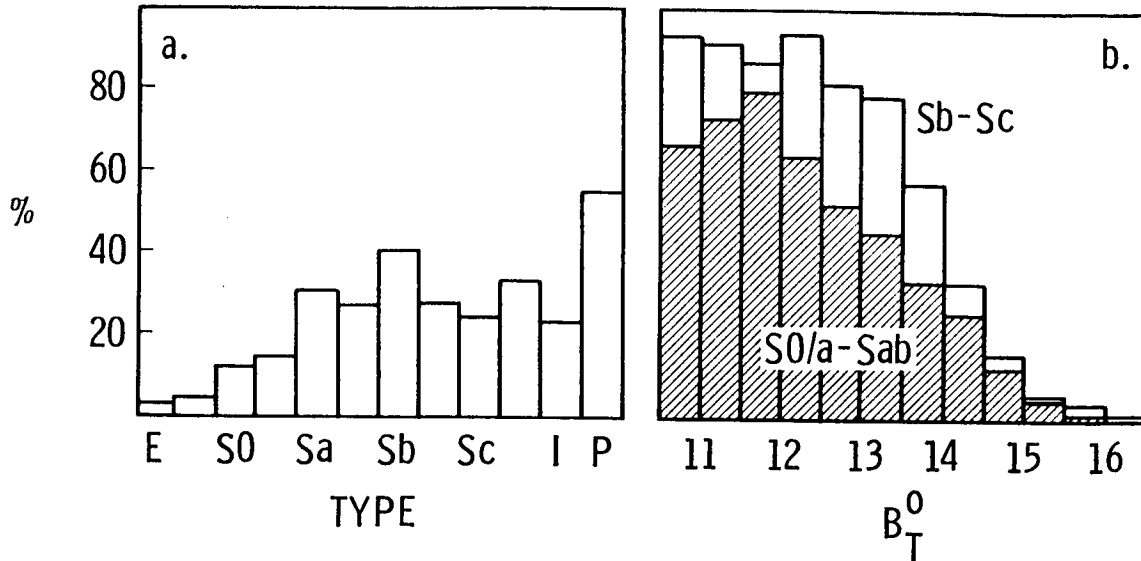
60 μ m DETECTION RATES FOR UGC GALAXIES

Figure 1 The 60 μ m detection rate of UGC galaxies is shown as a function of Hubble type (a), and, for two type ranges, as a function of blue magnitude (b). The 'I' class refers to Irrs, and the 'P' class to Peculiars. The blue magnitude is corrected for Galactic and internal extinction as in de Vaucouleurs, de Vaucouleurs and Corwin (1976).

(ie. a galaxy at the 'knee' of the optical luminosity function; Schechter 1976). For an IR/B ratio of 0.6, which is typical of 'normal', optically-selected spirals (see Figure 2), an L_{opt}^* galaxy can be seen by IRAS to a velocity of 6000 km/s, and would have a blue magnitude of 14.2 at the limit of detectability (see Bothun, Lonsdale Persson and Rice 1987 for full details). Thus an galaxy sample extending to significantly fainter magnitudes or higher velocities will be biased towards starburst and active galaxies with high IR/B ratios. In particular, we would point out that the IRAS catalog is not an unbiased survey of structure on a 2-300 Mpc scale, as claimed by Lawrence et al. (1986), and that studies of the large-scale distribution of matter using the IRAS catalog as a data base (Yahil, Walker and Rowan-Robinson 1986; Meiksin and Davies 1986) must take into account the possibility that infrared-luminous galaxies may not trace the matter very well (cf. Smith et al. 1987).

The apparently high detection rate for 'peculiar' galaxies (Figure 1a) is undoubtedly largely due to a selection effect in the UGC such that an object with clearly evident morphological peculiarities is likely to be a high surface brightness (high specific star formation rate) interacting galaxy.

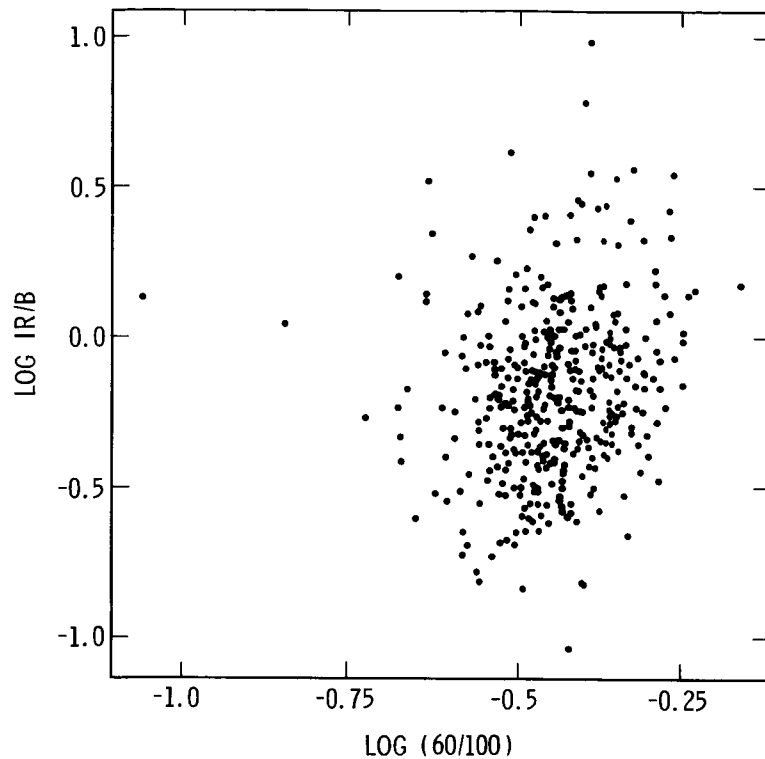


Figure 2 Dependence of the IR/B luminosity ratio on 60/100 μm color.

In Figure 2 we plot infrared-to-blue luminosity ratio versus 60/100 μm color. Here the infrared flux is the 40-120 μm flux derived as in Persson and Helou (1987), and the blue flux is defined as $\nu f_{\nu}(\text{blue})$. Several authors have found a general trend for the 60/100 μm color to increase with IR/B in IRAS-selected galaxy samples. We find little evidence for such a correlation in our large optically-selected sample. We also find a very large scatter in plots of the blue surface brightness vs. IR/B ratio and 60/100 μm color (not shown here). Thus while it may be true that the most luminous IRAS galaxies are warm objects powered by starbursts or active nuclei, it does not follow that star formation is the primary source of the far-infrared luminosity of a typical late-type galaxy. It is, rather, likely that for many galaxies, much of the far-infrared emission is from the diffuse interstellar medium, heated by the interstellar radiation field (cf. Lonsdale Persson and Helou 1987).

Burstein and Lebofsky (1986) have found that the IRAS detection rate of UGC galaxies decreases with increasing inclination. We have verified this important result, but are unable to find support for Burstein and Lebofsky's interpretation that galaxies are optically thick in the far-infrared, and that the far-infrared emission must arise predominantly in the nuclear regions. As illustrated in Figure 3, there is no dependence of 60/100 μm color on inclination, which would be expected if the disks are optically thick. We do

not find any strong dependence of IR/B ratio on inclination either. Burstein and Lebofsky's conclusion is also inconsistent with the IRAS maps of nearby, spatially resolved galaxies (Rice et al. 1987), which show that the far-infrared flux is not strongly confined to the nuclear regions.

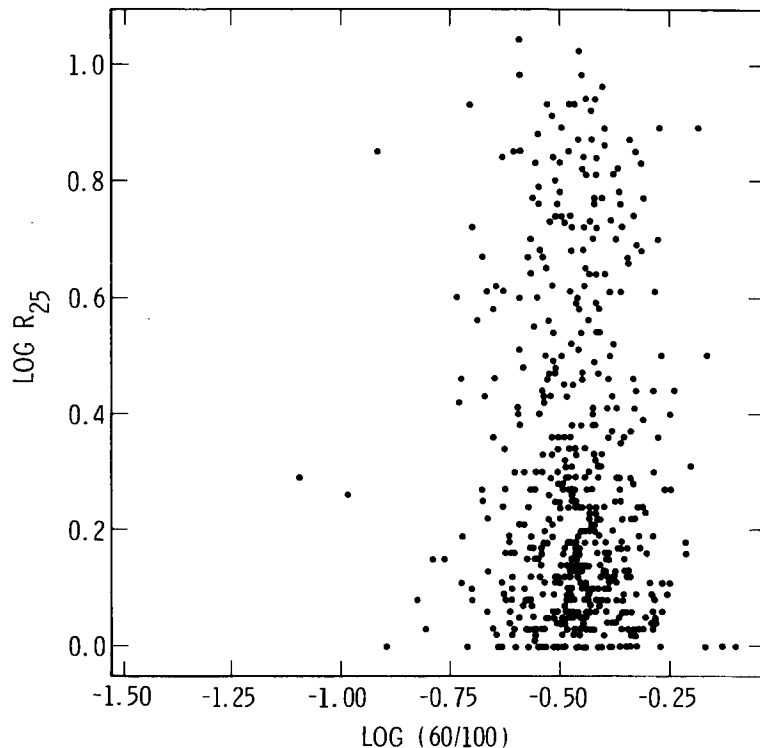


Figure 3 Inclination dependence of the 60/100 μm ratio of UGC galaxies. R_{25} is the major to minor axis ratio at the 25th mag. isophote, thus edge-on galaxies lie at the top of the figure.

3. REFERENCES

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